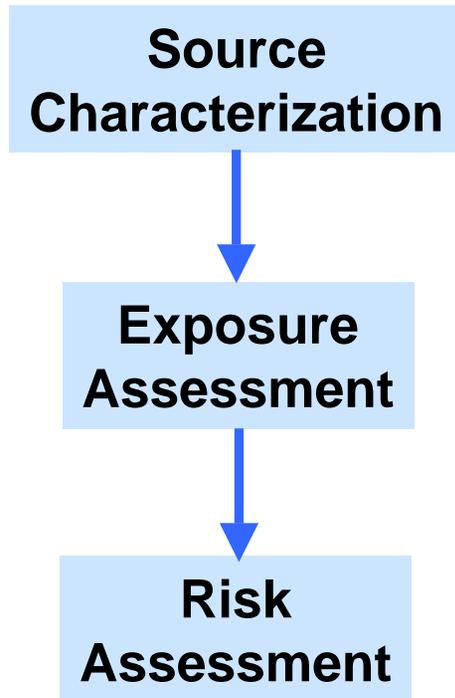


Contaminant Transport and Bioaccumulation Modeling

Kevin J. Farley, Manhattan College, HydroQual, NYU SBRP Center



Purpose of Modeling

- To confirm / extend interpretation of field data
- To determine contaminant contributions from various sources
- To provide forecasts of future conditions under various remedial options
- To evaluate relevant mechanisms controlling contaminant transport and bioaccumulation



CARP

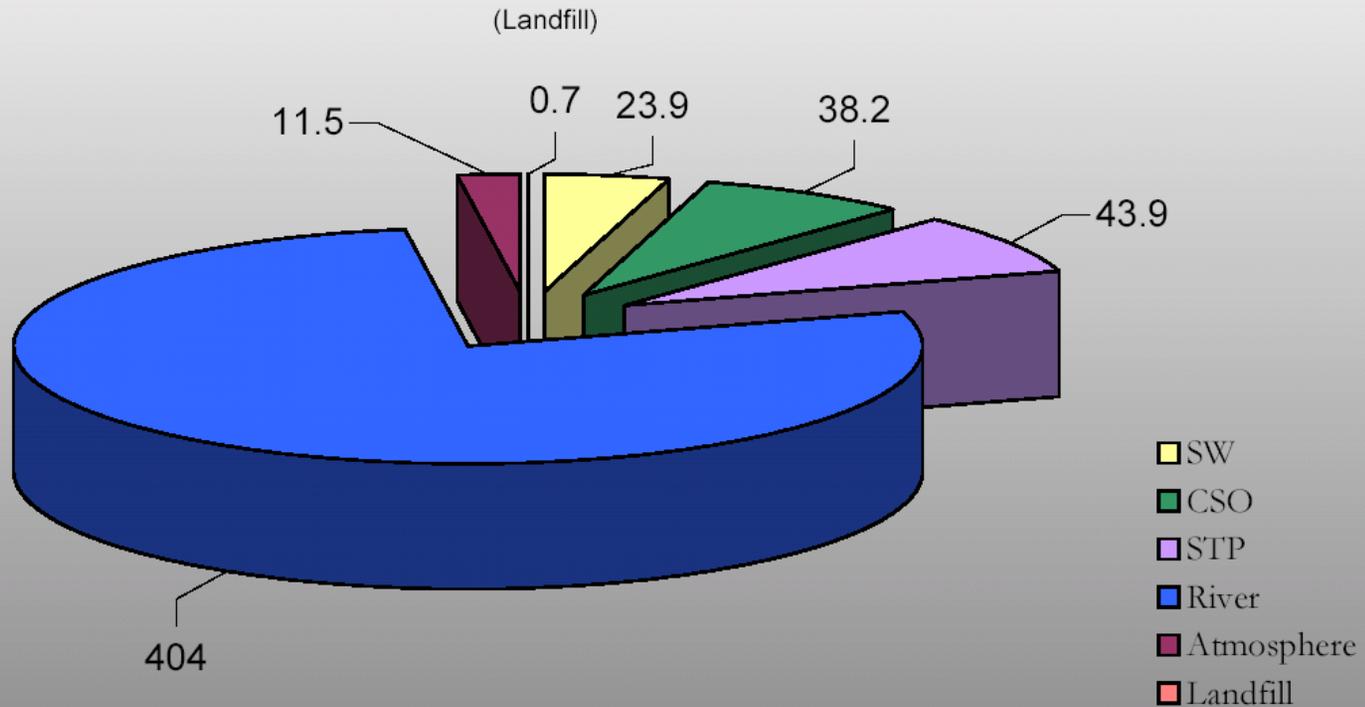
Contaminants

- PCBs
- Dioxins
- Furans
- Hg
- meHg
- Cd
- PAHs
- Pesticides
- etc.

Source Characterization

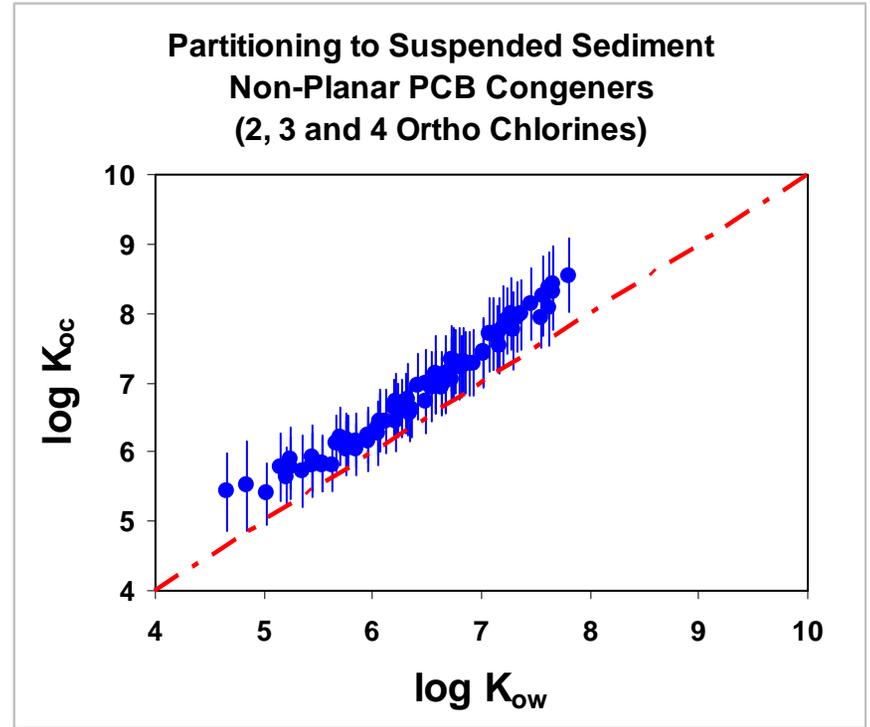
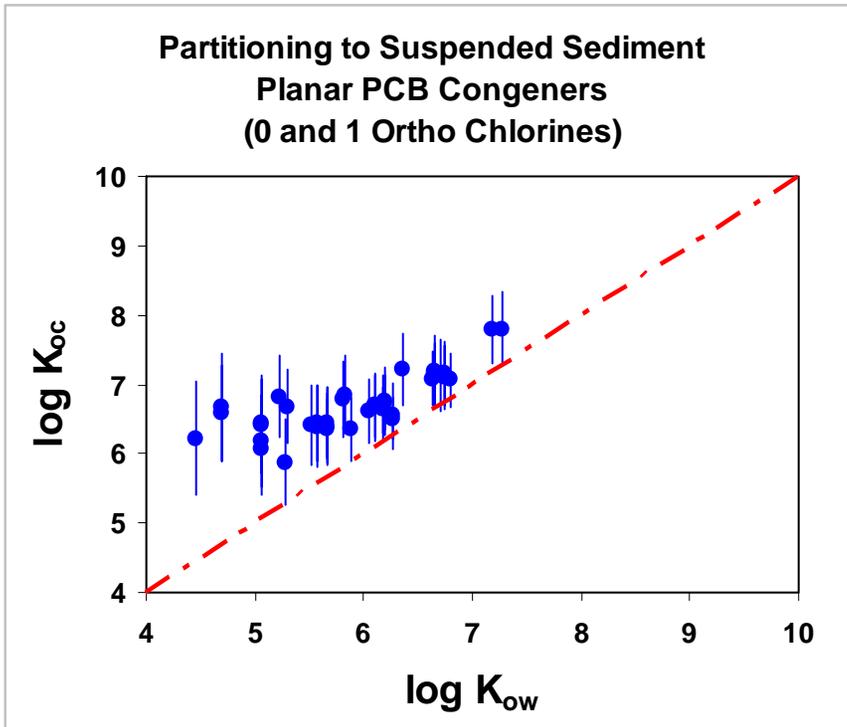
(34 Tributaries, 99 STPs, >1,000 CSOs and SWOs, plus atmospheric and landfill inputs)

Total PCB Loads (kg/year) Distribution
Mean of Loads Under 1998-99 and 1999-00 Flow Conditions - 522 kg/year

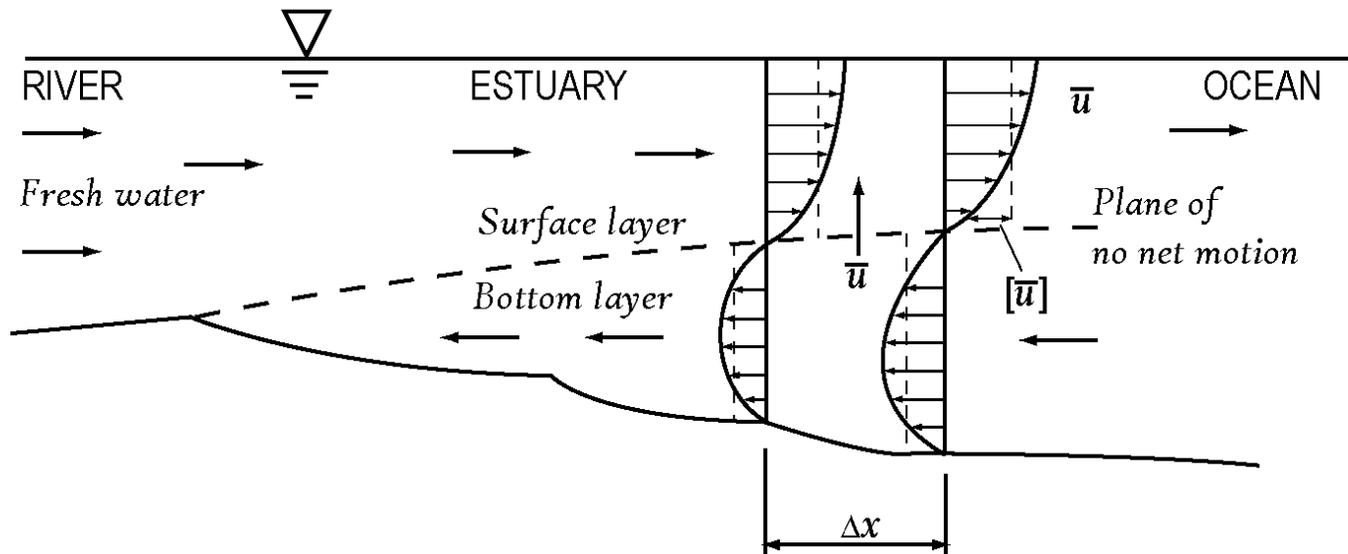


Contaminant Fate Processes

(hydrodynamics, sediment transport, organic carbon cycling, sorption, volatilization, chemical transformations)

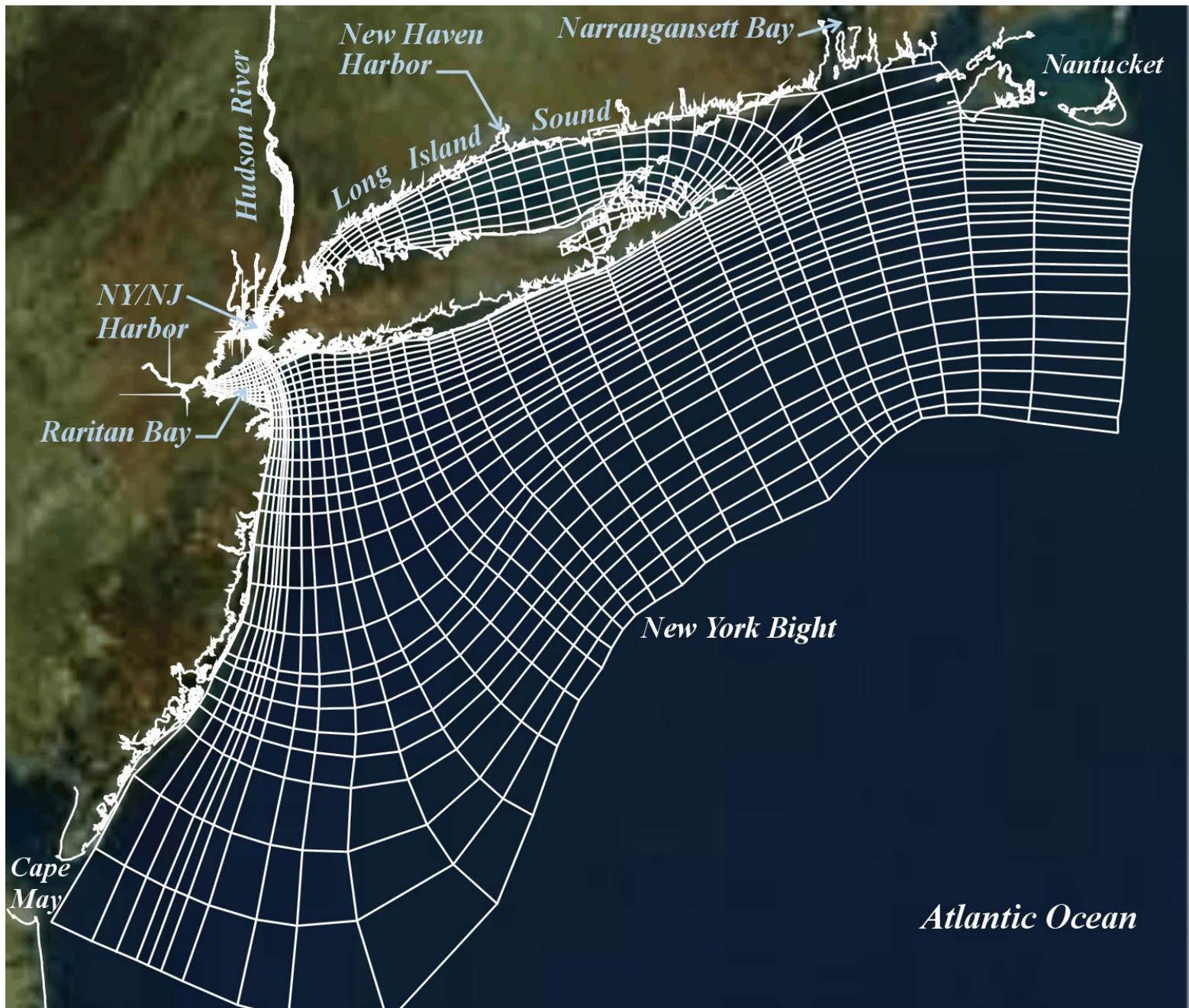


Estuarine Circulation



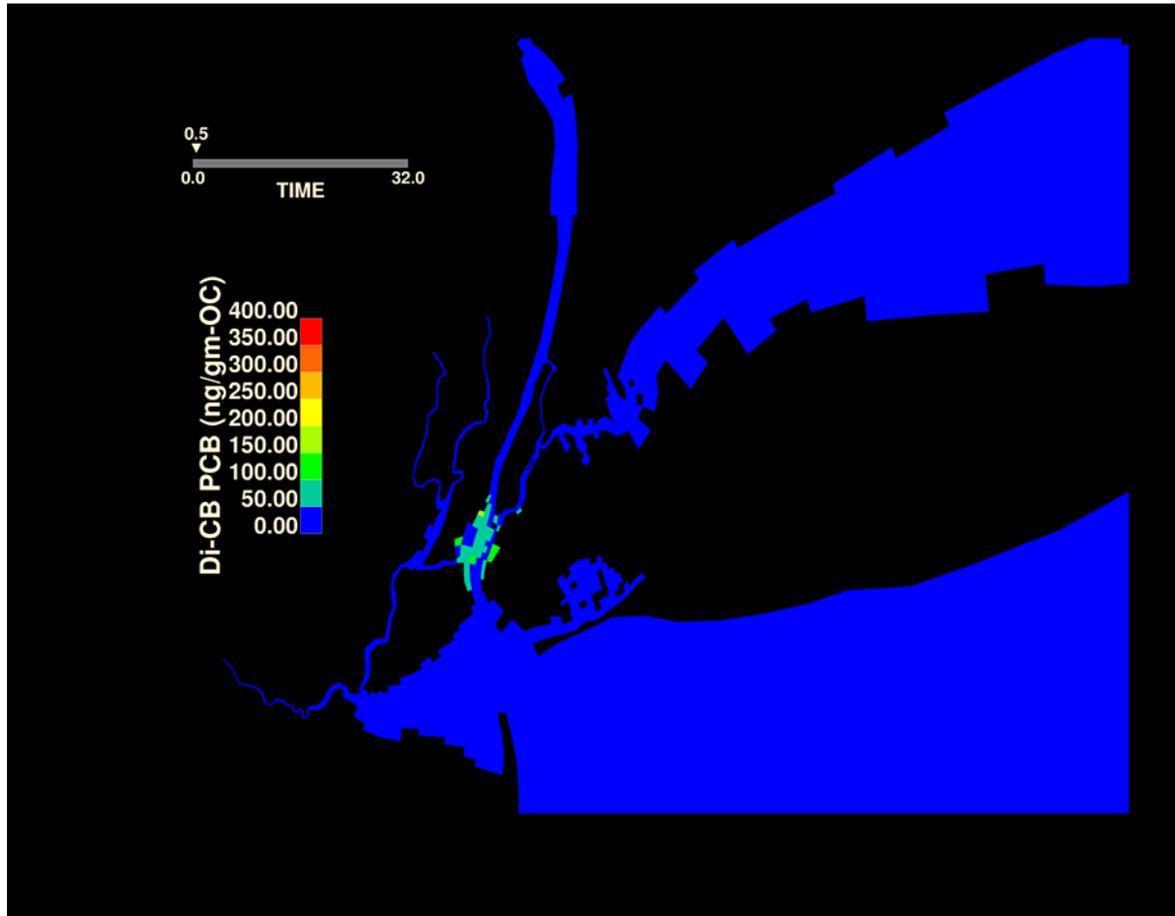
From Schnoor, 1996

Model Grid: 16,000 water column and 16,000 sediment cells



Passaic Valley Sewage Discharge

Release of 3,3'-dichlorobiphenyl: BZ#11



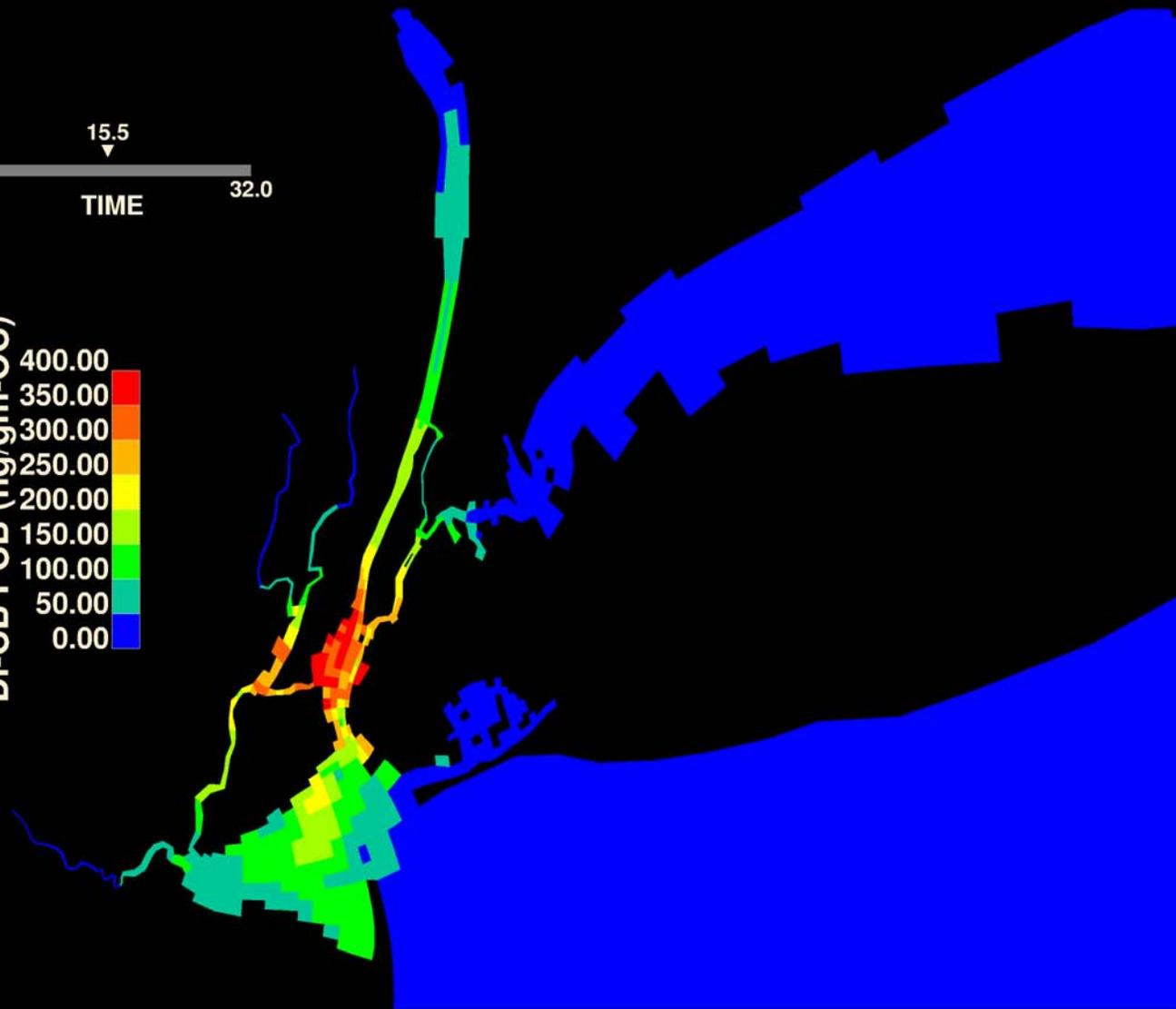
pvsc_16yrW_16yrNWdi.exe



pvsc_16yrW_16yrNWocta.exe

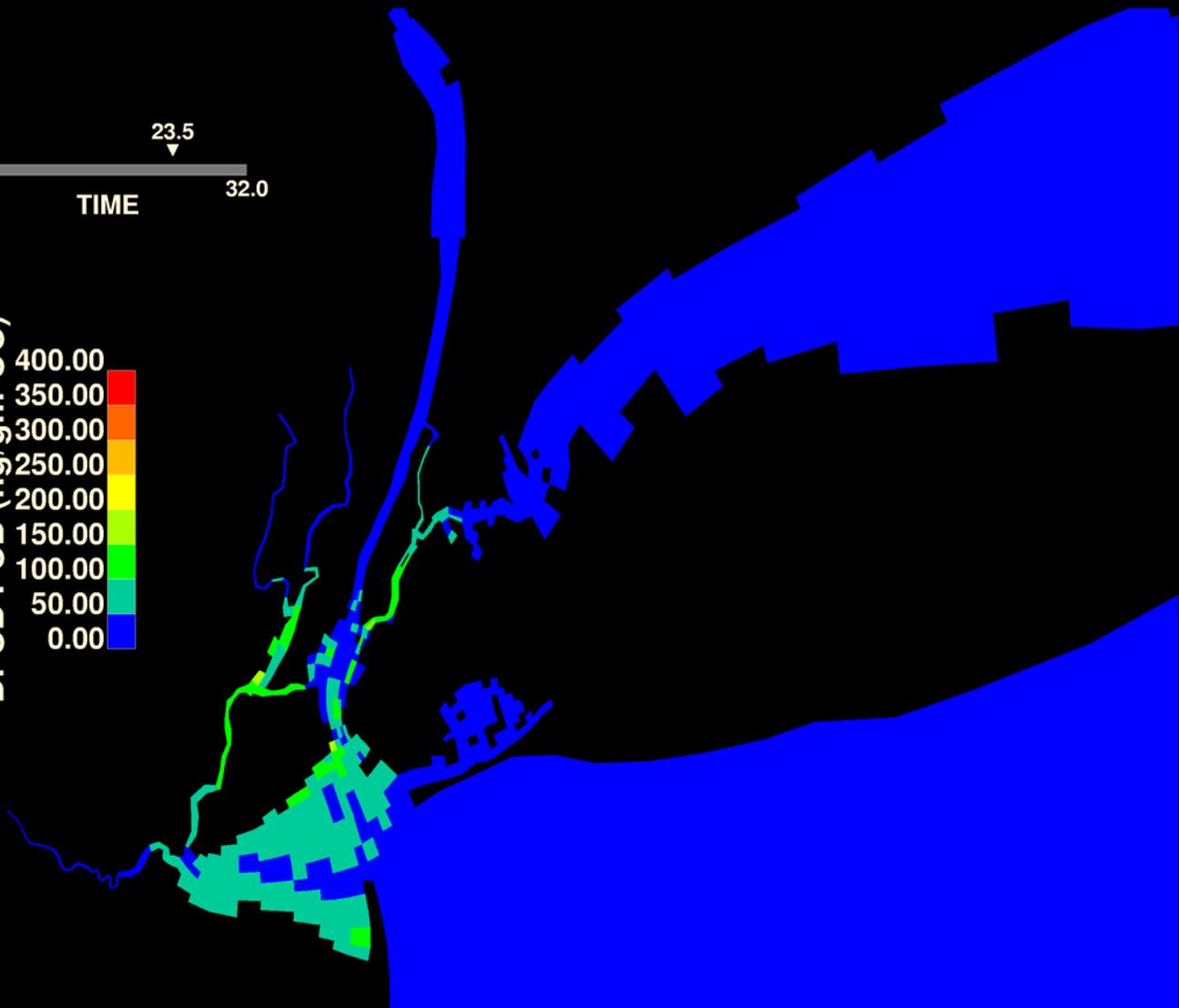


Di-CB PCB (ng/gm-OC)



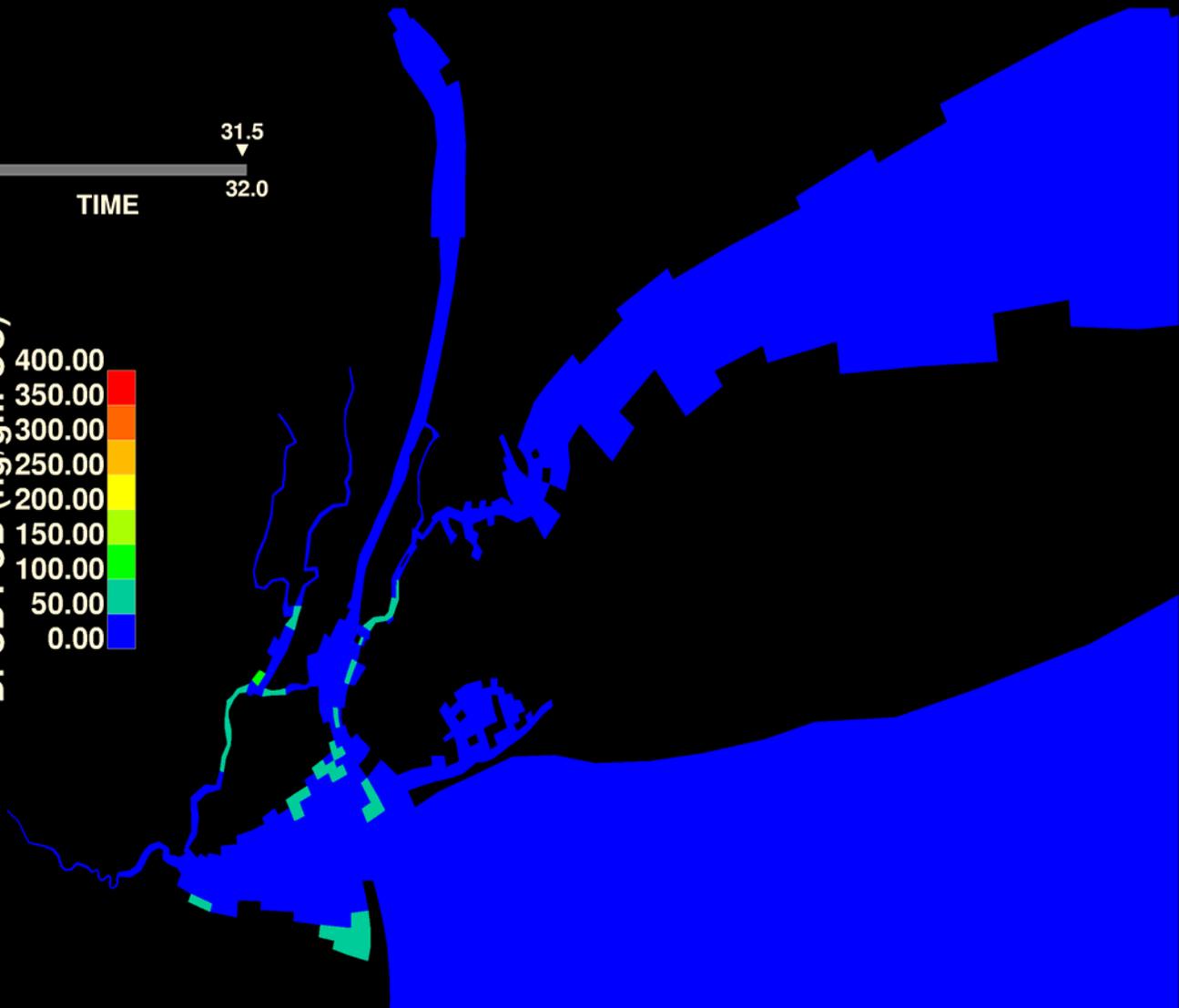


Di-CB PCB (ng/gm-OC)



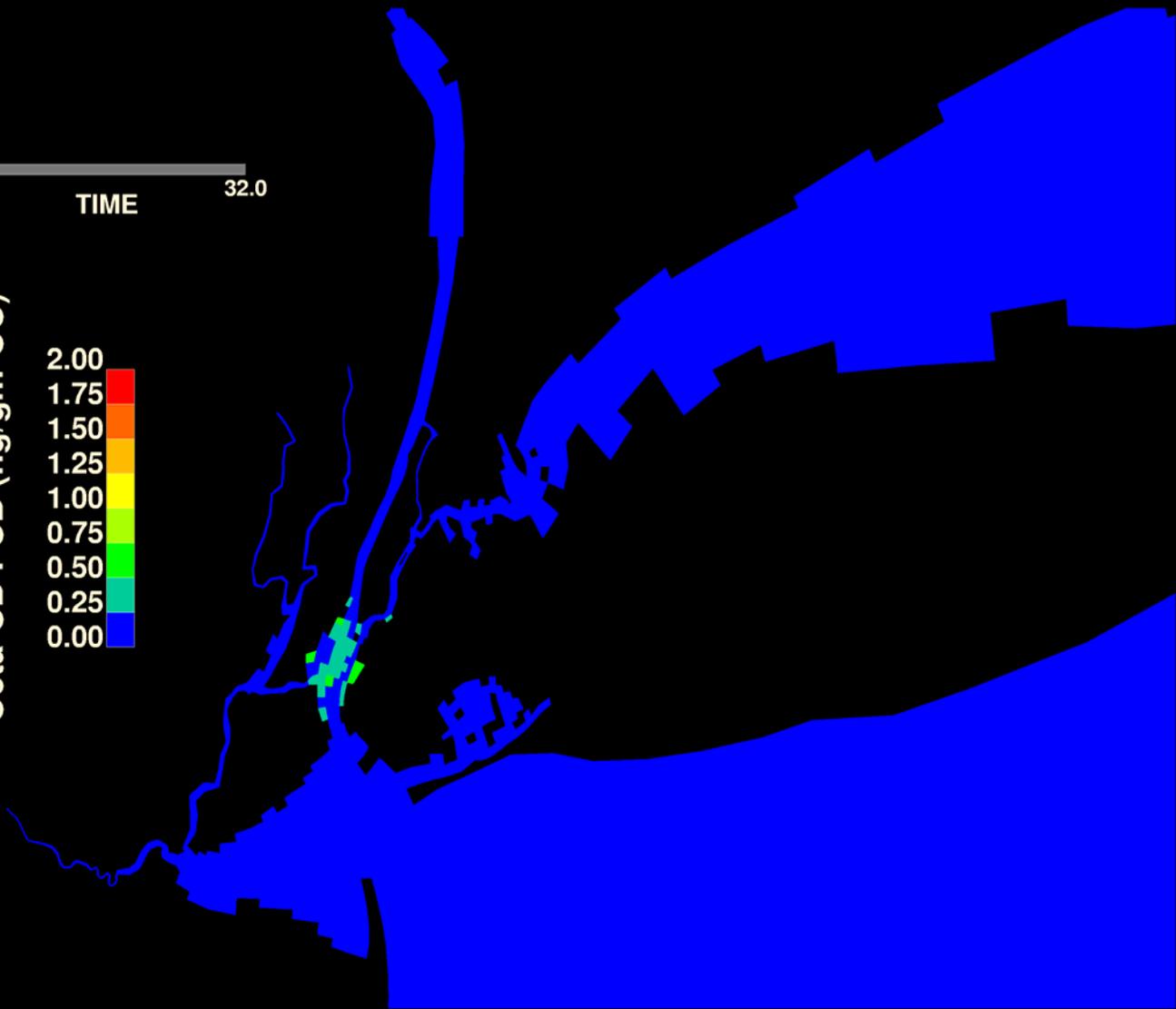


Di-CB PCB (ng/gm-OC)



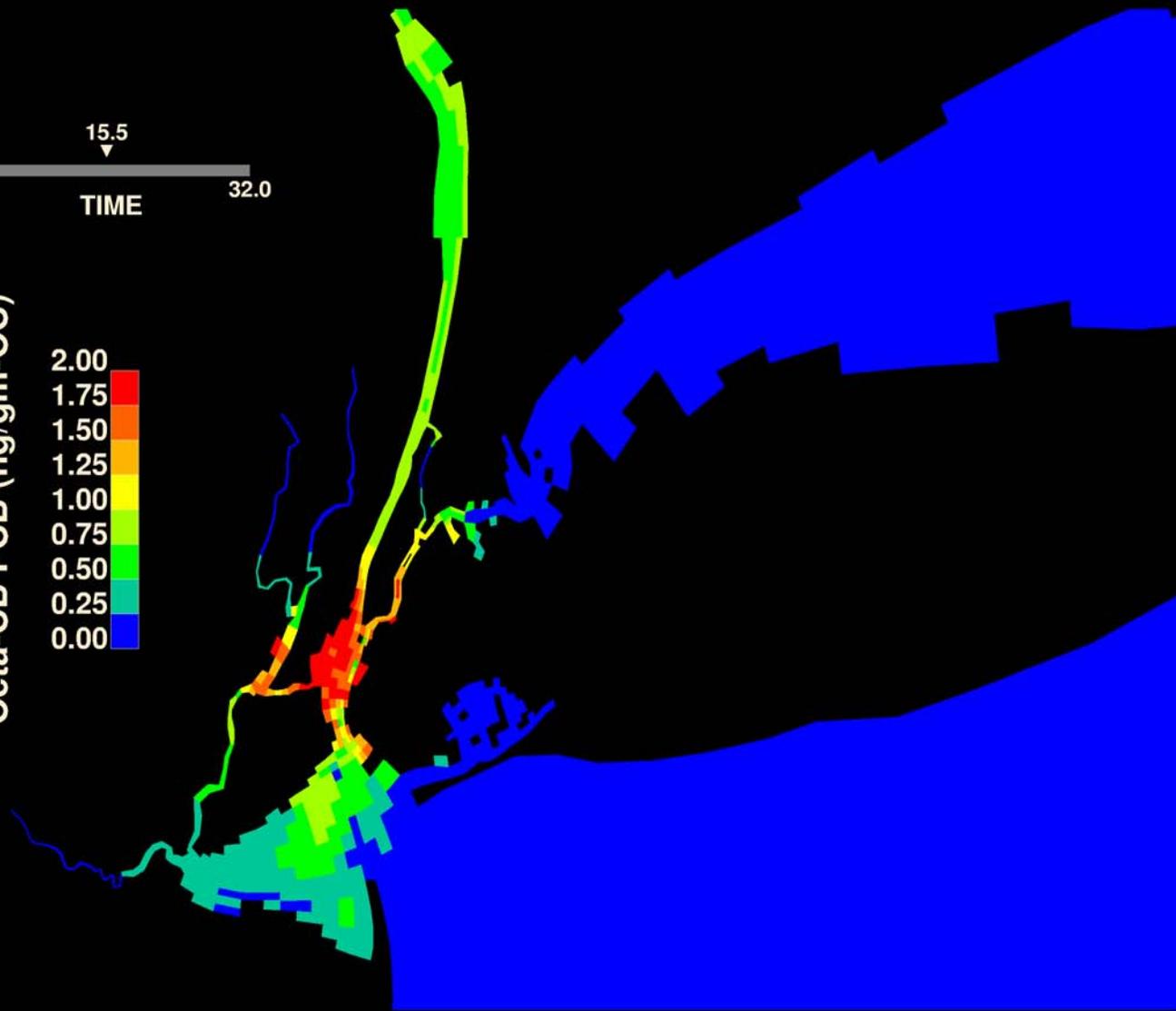


Octa-CB PCB (ng/gm-OC)



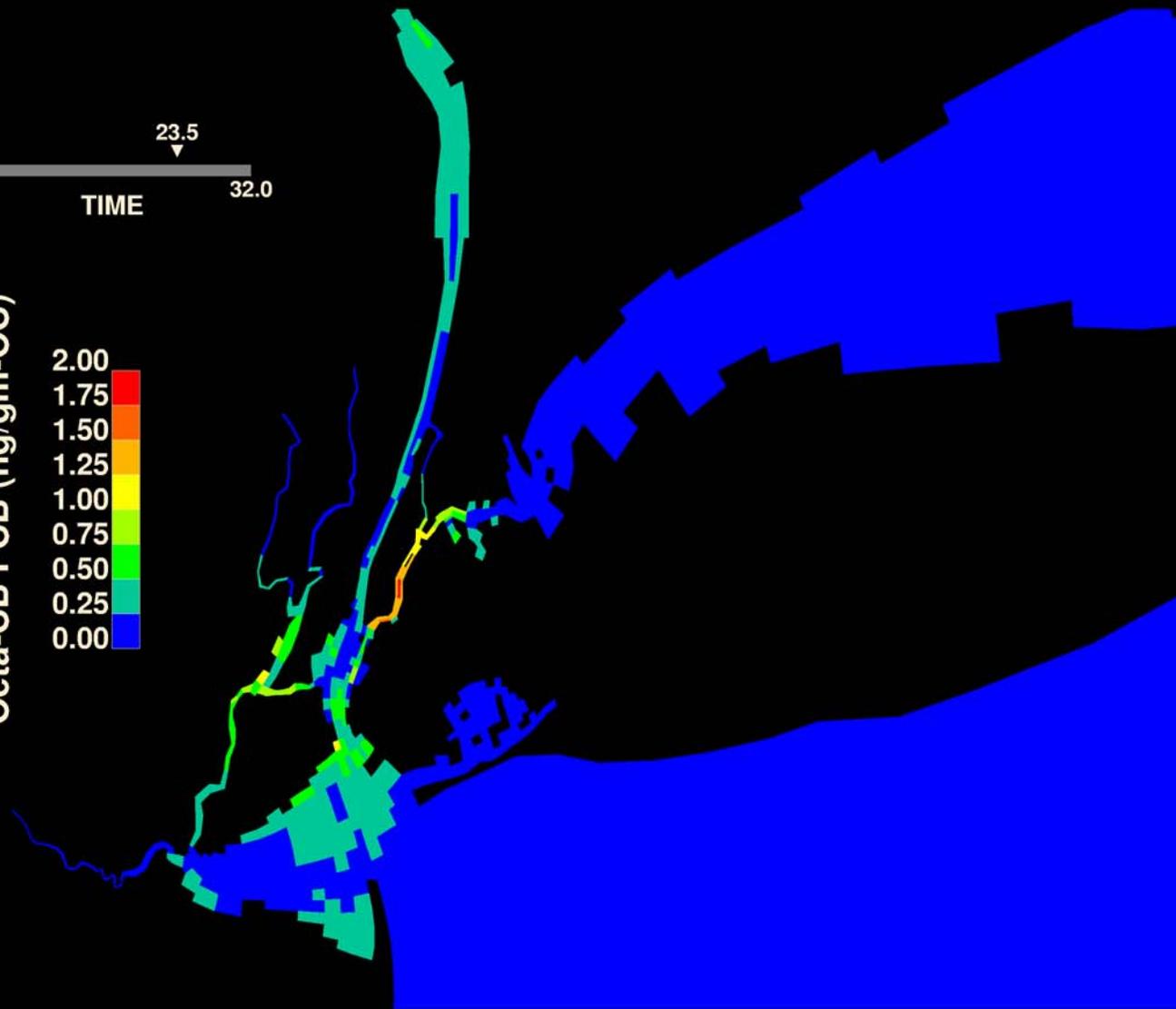


Octa-CB PCB (ng/gm-OC)



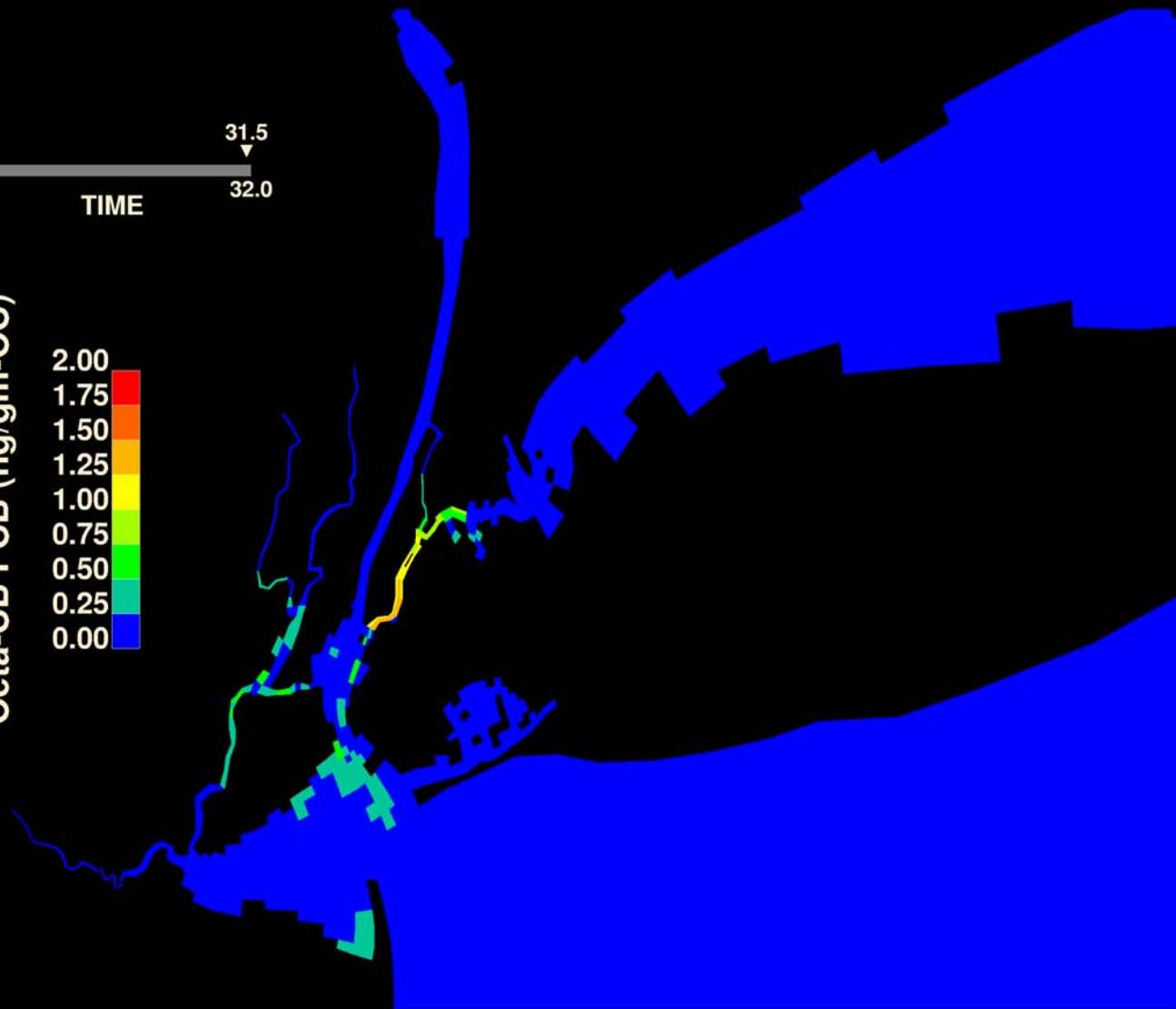


Octa-CB PCB (ng/gm-OC)



0.0 31.5 32.0
TIME

Octa-CB PCB (ng/gm-OC)





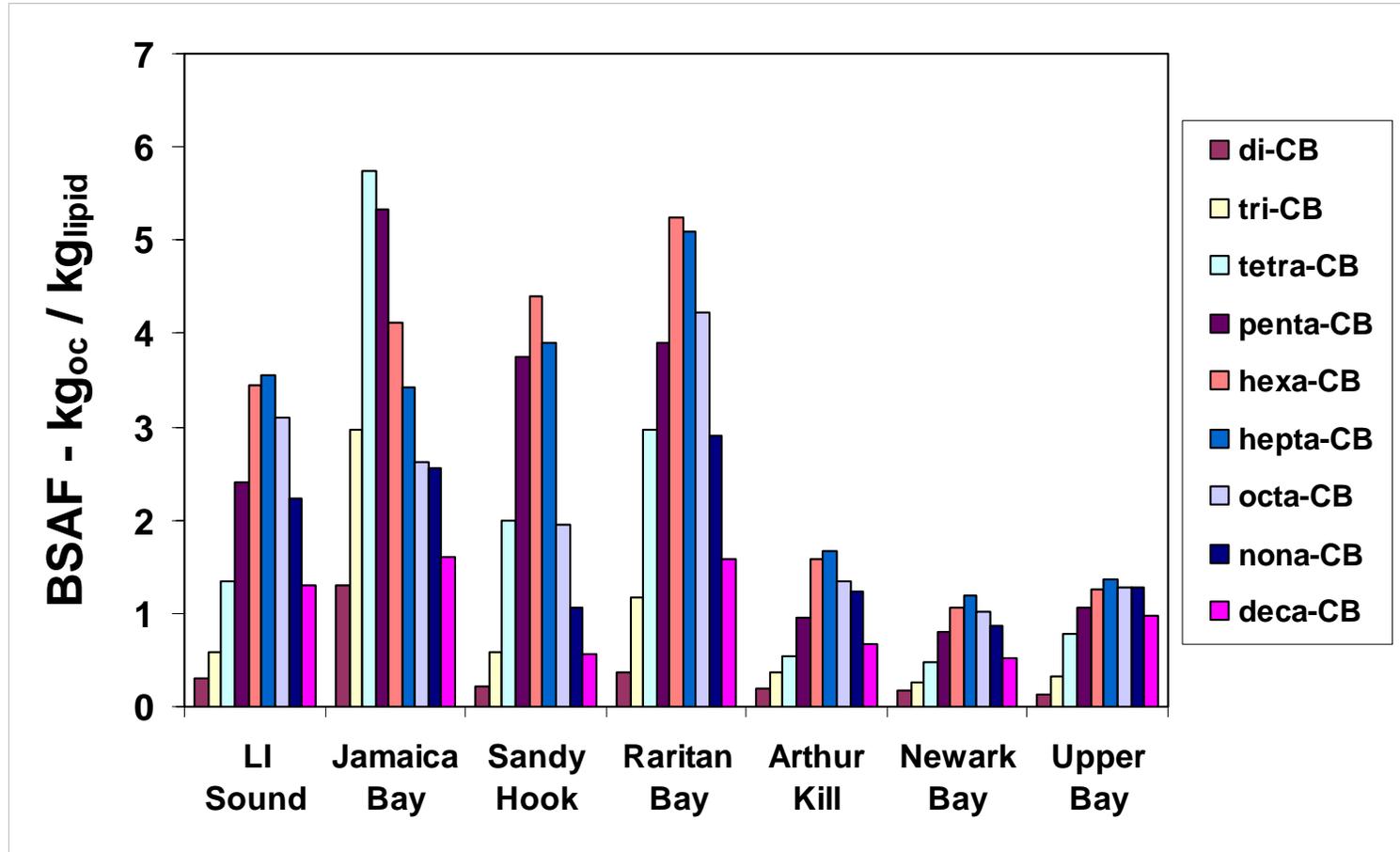
Contaminant Transfer through Aquatic Food Webs

Bioaccumulation Modeling

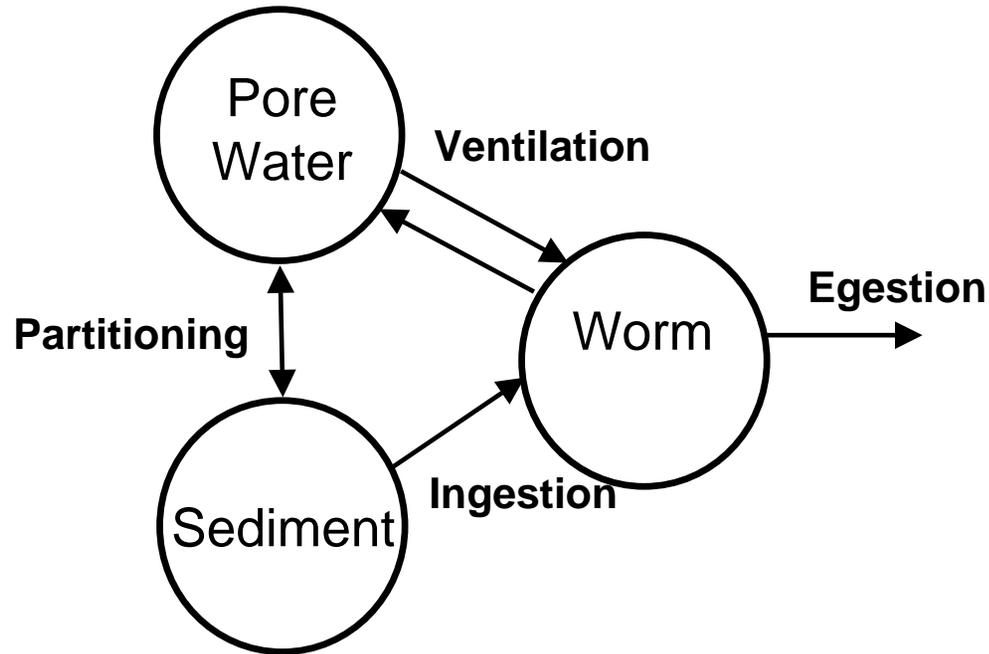
Courtesy of John Waldman, Hudson River Foundation

CARP: Harbor Worm Data

$$BSAF_{lipid} = \frac{V_{lipid}}{\Gamma_{oc}}$$



Bioaccumulation Model⁽¹⁾

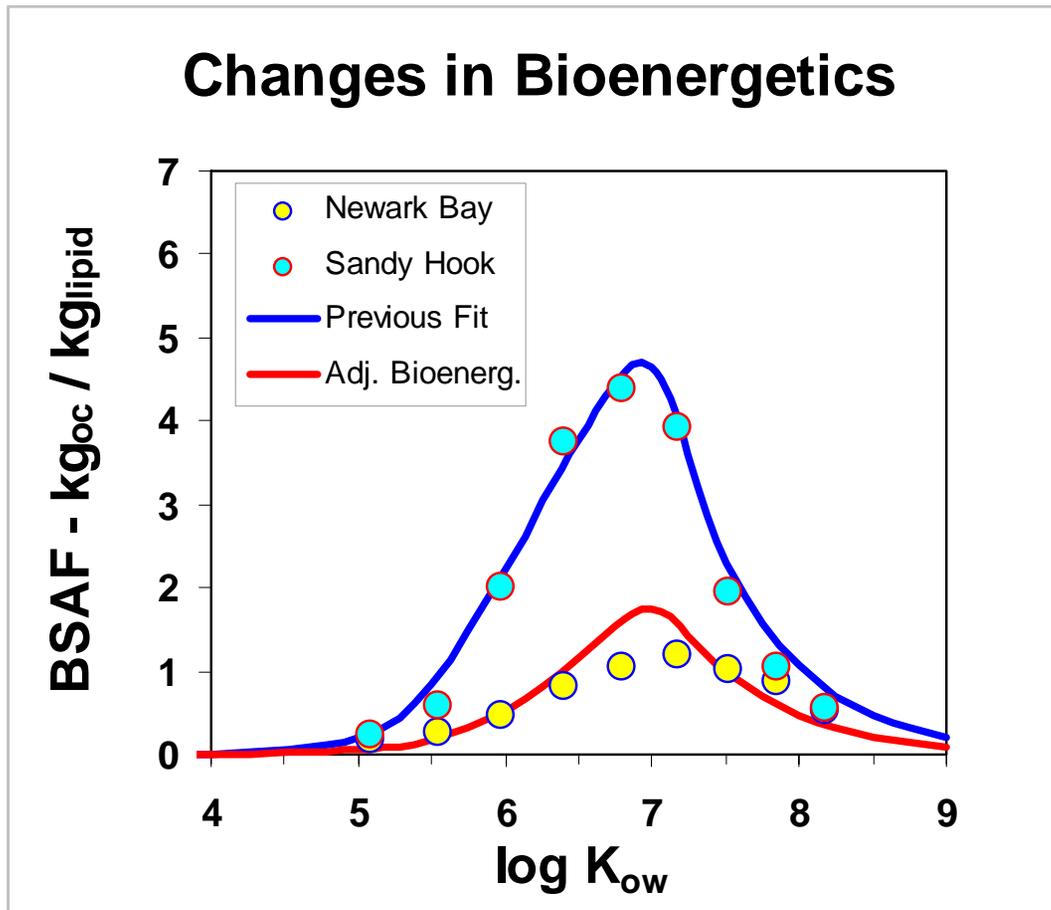


$$\frac{dv_{lipid}}{dt} = k_u C_{dis} + \alpha I_{oc, lipid} \Gamma_{oc} \left[\frac{K_{lipid}}{K_{oc}^{app}} \right] - (k_e + k_g) v_{lipid}$$

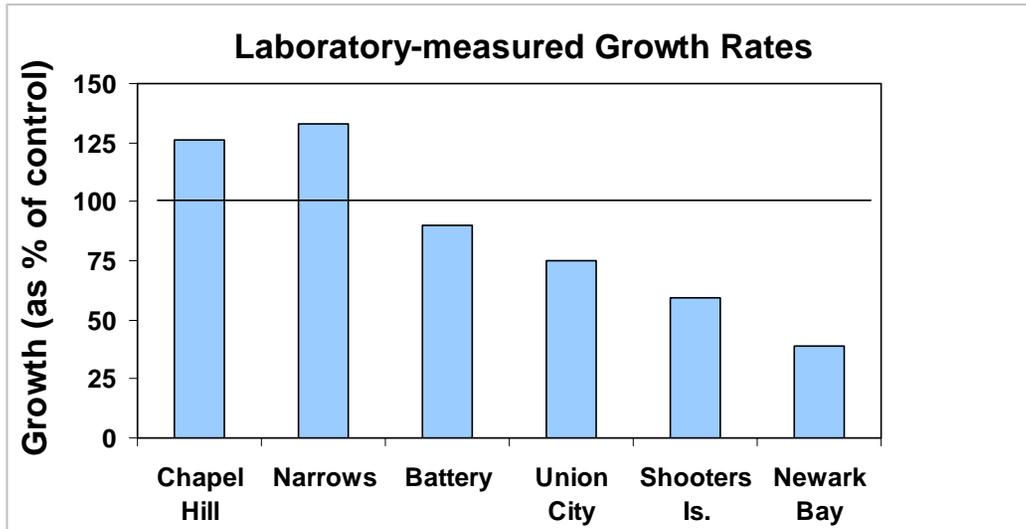
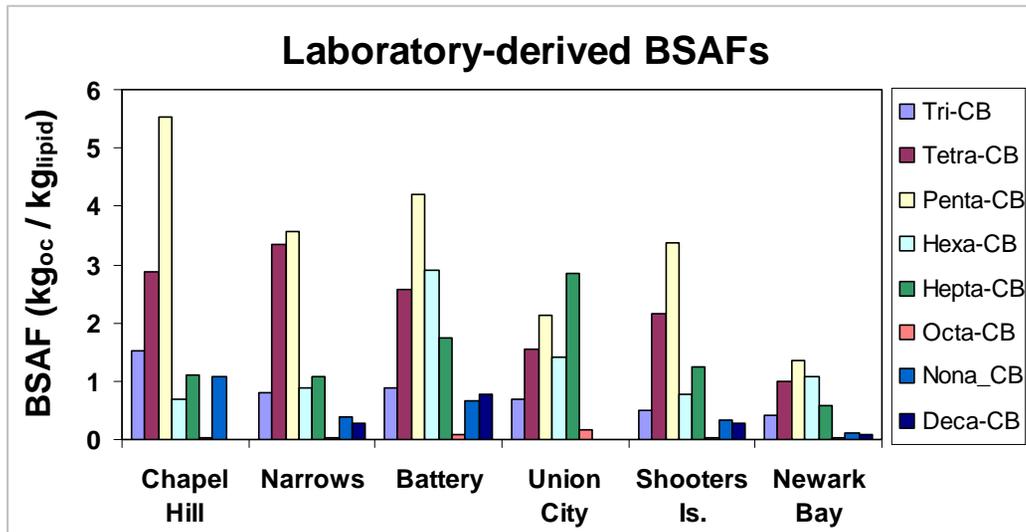
(1) Thomann, Connolly and Parkerton, *Environ. Toxicol. Chem.*, 1992

Bioaccumulation Modeling

Changes in organism bioenergetics with levels of contamination



“Urban myth” or serious implications in setting targets for sediment cleanup



Controlled Laboratory Tests

- 10-day Bioaccumulation Tests⁽¹⁾
 - Non-deposit feeding amphipod (*Rhepoxynius abronius*)
 - Deposit feeding polychaete (*Armandia brevis*)
- 20-day Growth Tests⁽²⁾

(1) Meador, Adams, Casillas and Bolton, Arch. *Environ. Contam. Toxicol.*, 1997

(2) Rice, Plesha, Casillas, Misitiano and Meador, *Environ. Toxicol. Chem.*, 1995

Summary

- ❑ Overview of contaminant transport modeling
 - ✓ Partitioning to sediment
 - ✓ Estuarine circulation
- ❑ Challenges in evaluating contaminant transport in complex estuarine environments
- ❑ Issues in bioaccumulation
 - ✓ Effect of contamination levels on bioaccumulation behavior

Acknowledgments

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- ❑ NIEHS-SBRP
- ❑ The Hudson River Foundation
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- ❑ EPA

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- ❑ Robin L. Miller
- ❑ James R. Wands

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